

Chemical Processes : Distribution coefficients of 50+ elements on newly synthesized Inorganic resin

Review Date:

Location of work: building 801, Room 2-37 (shared with the Nuclear Chemistry Summer School)

- The studies will not use radioactivity.

Purpose of experiments:

The purpose of this experiment is to measure the distribution coefficients (K_d) of a large number of cold elements (periodic table page 1) at different pH ranges in nitric, hydrochloric acids, sodium acetate or other aqueous buffer on different inorganic ion-exchangers that have been synthesized in our laboratory. The synthesis of these resin were submitted and accepted in the proposal named: Synthesis of inorganic ion-exchange materials hydrothermally (presented by Dr. Dimitri Medvedev).

Hazards and controls associated with the work:

Chemical Hazards:

➤ **Existing hazards:**

- ✚ Corrosive, oxidizers (strong acids and base).
- ✚ Chemical burns, ingestion, inhalation, absorption through skin.

➤ **Default controls:**

- ✚ General PPE to include cotton lab coat, safety goggles, and impermeable gloves when handling chemicals.
- ✚ All the operations with a 250 ml of volumetric hazardous chemical quantities in hood.
- ✚ Register commercial chemicals in CMS
- ✚ Work alone after hours only if permitted by supervisor
- ✚ Food, beverage, smoking and cosmetics are prohibited.
- ✚ Unobstructed access to emergency Eyewash and shower.
- ✚ All the used elements are non-radioactive and of improved chemical grads.
- ✚ Spills: Small spills can be absorbed in paper towels moisten with water. Larger spills can be absorbed in clay absorbent material.

Experimental procedure:

1. Prepare 0.5M sodium acetate solution with a different pH range (between ~0 and 12).
2. Into the previously prepared solutions add a definite amount from the selected element.
3. Weight m_x grams of the selected resin in 16 mL polypropylene conical vials (with a stopper).

- Pour the aqueous phases V_x into the vials containing the resin and shake for definite time t (typically 24-48 hours).
- Separate the aqueous phases by using micro filter (0.22 μm) or by centrifugation.
- Dilute (D_x) the aqueous phase in 2% HNO_3 .
- The non-radioactive samples in test tubes will be removed from room 2-37, and ICP-OES will be performed in the RRPL to determine the metal concentration.
- The metal concentration in the initial aqueous phase before shaking (C_i) and after shaking (C_a) will be calculated.
- Calculate the distribution coefficient using the following equation:

$$Kd = ((C_i - C_a)/C_a) * (m_x/V_x)$$

Materials Used:

Ion-exchangers:

- Sodium nonatitanate (SNT), Sodium titanium silicate (CST), Alpha zirconium phosphate ($\alpha\text{-ZrP}$), Titanosilicate with pharmacosiderate like structure (TSP)

Equipment/solutions

Shaker, pipettes, pipette tips, single element standards for ICP, ICP tubes, tubes used in the study, hydrochloric acid, Nitric acid, Sodium Acetate, pH meter, balance, centrifuge, filters

1 IA		2 IIA										13 III A	14 IV A	15 VA	16 VI A				
2	2s	3 Li lithium 6.941	4 Be beryllium 9.012									2p	5 B boron 10.81						
3	3s	11 Na sodium 22.99	12 Mg magnesium 24.31	3 III B	4 IV B	5 V B	6 VI B	7 VII B	8 VIII B	9 VIII B	10 VIII B	11 IB	12 II B	3p	13 Al aluminum 26.98				
4	4s	19 K potassium 39.10	20 Ca calcium 40.08	3d	21 Sc scandium 44.96	22 Ti titanium 47.87	23 V vanadium 50.94	24 Cr chromium 52.00	25 Mn manganese 54.94	26 Fe iron 55.85	27 Co cobalt 58.93	28 Ni nickel 58.69	29 Cu copper 63.55	30 Zn zinc 65.41	4p	31 Ga gallium 69.72	32 Ge germanium 72.64	33 As arsenic 74.92	34 Se selenium 78.96
5	5s	37 Rb rubidium 85.47	38 Sr strontium 87.62	4d	39 Y yttrium 88.91	40 Zr zirconium 91.22	41 Nb niobium 92.91	42 Mo molybdenum 95.94	43 Tc technetium 98	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	5p	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	
6	6s	55 Cs cesium 132.9	56 Ba barium 137.3	† 5d	71 Lu lutetium 175.0	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	6p	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	
																	</		

Chemical Processes

Distribution coefficients of 50+ elements on newly synthesized Inorganic resin

WORK PERMIT SIGN OFF SHEET

Signature implies that the worker understands the scope and limitations of the Work Permit and training is kept current.

Print Name	Signature	Date	Process Review /Date